

**RADIO FREQUENCY IDENTIFICATION (RFID) BASED PROXIMITY  
BRACELET FOR ATTENDANCE SYSTEM FOR GRADE SCHOOL STUDENTS**



**A Capstone Research Project Presented to  
The Senior High School Department  
Malayan Colleges Mindanao**

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**May 2022**

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The Senior High School Department of  
Malayan Colleges Mindanao

In Partial Fulfillment  
Of the Requirements for the  
Capstone Research Project Course

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## CHAPTER 1

### INTRODUCTION

#### **Background of the Study**

The manual encoding of attendance takes a long time and lacks a system. Educators are required to call out the names of each student one by one, and this process would consume time, especially for a large class. Another method is to distribute an attendance sheet to check their credentials and sign it. However, the only drawback is that students can be dishonest by signing on their friends' behalf. Integrating RFID or Radio-Frequency Identification in the attendance management system of schools has high efficiency for students and school staff alike. According to Shukla (2013), this system will be able to read students' attendance through the computer where the RFID is connected, which records the student's attendance. The system also provides ID registration, deletion, and transaction. The data collected will give a structured report of students' attendance. A system that can automatically capture students' attendance by flashing their student card at the RFID reader can save all the mentioned troubles. Nevertheless, the scanning process can cause inconvenience to some users, especially those who are far away from the scanning station. The existing systems present high performance; however, these systems still have gaps in some characteristics. In this particular study, the proximity system lacks functionality because of its high range; the system cannot detect the desired parameter.

An RFID system known as the R-BASAS device implemented in Nigeria. It is designed so that RFID devices installed in classrooms are used to gather and manage student attendance data. (Olanipekun & Boyinbode, 2015). The study of the R-BASAS device requires the student to have an ID with an RFID tag embedded. Students can now swipe their IDs to mark a new attendance session. Researchers utilized the versatility of RFID in implementing a functional and automatic student attendance recording system that allows students to fill their attendance just by swiping or moving their RFID cards over the RFID reader with a considerable degree of success and acceptability of usage in the faculty part of Nigerian school. The study conducted by the researchers lacks the frequency for they only use the Low frequency (LF) RFID tag instead of a High frequency (HF) RFID tag that can further enhance the performance and flexibility of the users.

In the Philippines, the study conducted by Swedberg (2018) shows the Portable Technology Solutions (PT's) Clear Stream RFID middleware. The RFID system implemented at the Saint Louis University in Baguio, Philippines, provides an ultra-high frequency (UHF) RFID that enables a faster, more reliable, and seamless entrance for the campus, as well as to offers management with more information on who came in and who left the campus. The RFID system used at Saint Louis University uses an Impinj Speedway R420 readers and Times-7 antennas at the checkout desks and portals for each doorway. The system also has a Zebra Technologies RFD8500 handheld UHF RFID reader used in Geiger counter mode. The PT's Clear Stream RFID middleware can also be used on high-value mobile assets like laptops, books, and papers, in which an alarm would be

set off if the system would detect any tagged items moving past it. The system prompts a text message for the elementary-aged children to be sent to parents, informing them that their children have arrived or left the campus' vicinity once the system records each badge's tag ID. Regardless of how beneficial and technologically advanced the PT's Clear Stream RFID middleware is, it is still vulnerable, as it uses IDs which is prone to get lost; other people can easily use that to steal your identity or even enter the school premises with the use of the stolen ID, the system can also be hacked or bypassed by someone tech-savvy, so they are not foolproof. In addition, due to the system's complexity, it requires to be constantly programmed or updated by someone who specializes in such a system which can be hassle and expensive if any problems may occur in the system. In the local setting, the University of Mindanao has one of the largest libraries in Region 11, Philippines. It is a general library rule that before entering the library's circulation area, all users and guests should deposit their bags at the baggage desk. The study aimed to automate the manual process of depositing and claiming baggage in the library while also ensuring security and convenience. The RFID scanner will read the RFID card as personal identification for the user. The data read by the RFID reader is interpreted by the Arduino microcontroller, which is sent to a desktop computer's software. The thermal printer will generate a barcode receipt that contains the transaction time and date, user, assigned storage, and the generated security key. Upon claiming, the security key will be scanned with a barcode reader. Furthermore, the software is developed to handle the interaction between the user and the system. The software also signals the Arduino

microcontroller, which uses a solenoid lock to lock or unlock the selected storage shelf. (Villosa & Pangintahon, 2017). However, the automated self-baggage system lacks in some aspects. The RFID cards and the printed barcode receipt is prone to be misplaced and getting lost, which can cause inconvenience for the users to commence the process to claim their baggage.

To minimize time consumption in checking and monitoring the attendance, the researchers developed a way to utilize RFID and automate this process. According to American Barcode & RFID (2021), RFID stands for radio-frequency identification, which employs electromagnetic fields to automatically detect and track tags attached to things. The RFID Attendance System will have two parts to make it work; the receiver where all the data sent by the user will be compiled and stored, this consists of an Arduino Nano, NRF24L01 module, RTC Module, Micro SD Card module, and is powered by a 9V Battery. At the same time, the transponder consists of an Arduino Nano and an NRF24L01 which a 9V Battery will power. Upon the time the user reaches the vicinity of the receiver's signal, it will directly send that user's information; name, and the time it enters the room. This also applies when the ID user goes out of the receiver's vicinity or room, sending another message containing the user's name and the time it goes out of the room. Additionally, using the proximity switch, the user's attendance will directly register within the room parameter. This also applies when the user is not within the parameter, the proximity switch will turn off indicating that the user is out of range. The developers will carry out a project in which they will use an RFID-based and proximity system to validate students' attendance.

**Project Objectives:**

This research project aims to develop the attendance system by automating it by integrating RFID into the process. This research project study aims to achieve the following objectives at the end of the course:

1. To design the RFID-based proximity bracelet for the attendance system.
2. To test the RFID based proximity bracelet in terms of its:
  - a. Functionality
  - b. Performance
  - c. Reliability
3. To develop the system and the product design of the attendance monitoring system.

**Significance of the study**

This project aims to design the RFID-based proximity bracelet for the attendance system. This project will benefit the following:

*Grade school students.* This project will be able to help the students lessen up the time to fill in the necessary data needed to log the student's attendance in school.

*Grade school teachers.* Educators will be able to oversee the daily activities of the students that ensures security for the students. Also, the project will be able to minimize the time consumes in checking the attendance of the students providing the educators to have more time in teaching.



*Educational Institutions.* The research project may help the school to have a systematic and organized attendance monitoring system. Providing the name, and the time the student enters and exits the room.

*Parents/Guardian.* The system will notify the parents informing them that their children have arrived or left the campus' vicinity. In this way, the project will be able to help the parents to ensure the safety and security of their children.

*Government Sector – Department of Education (DepEd).* This study aims to have a systematic and organized attendance system and to provide the security of the students. Considering the mission and vision of DepEd this study may provide information that can aid the improvements of this sector.

*Future researchers.* Researchers who wish to conduct a similar project may use this as a reference. They may consider the recommendation(s) provided by the researchers for their research.

### **Scope and delimitation of the study**

The general intent of the study is to carry out a project in which an RFID proximity system will be utilized to speed up validating students' attendance in which UHF RFID tags can read at ranges as far as 12 meters with a passive RFID tag. This project will be limited to designing the RFID-based proximity bracelet for the attendance system. Furthermore, this project will be participated by industry experts to test and assess the functionality, reliability and performance of the product. However, due to the Coronavirus (COVID-19) pandemic restrictions, and time bounded constraints, the researchers will be only presenting the project model design of the device.

It will be expected to have a prototype model of the device at the end of the course. The project will be conducted online and will be performed within five months, from January to May 2022. This project will be conducted during the academic year 2021-2022 of Malayan Colleges Mindanao.

## **CHAPTER 2**

### **REVIEW OF RELATED LITERATURE AND SYSTEM**

This chapter of the research paper will adequately present reviewed related literature regarding Radio Frequency Identification (RFID) attendance system. Particularly, it will expound on the features, definition, and usability within different settings. The issues that arose using these systems will also be discussed along with the system development tools used in the study. This section will review the five (5) systems related to the radio frequency identification (RFID) based proximity bracelet for attendance system for grade school students. Furthermore, the theoretical and conceptual framework, as well as the operational definition of terms, will be discussed to elucidate the project's goals. The section of the review of related literature will develop the groundwork for the analysis of the development and design of the research project to be procured from the related literature and related system.

#### **Related Literature**

This section of the paper will summarize writings of the studies, knowledge and principles from published authorities and present research. The developers will expound on the features of various projects, their applications in different settings, and the issues that arose while using these systems. Furthermore, the factors and system development tools used in the study will also be presented.

This literature will enlighten developers on what is already known as well as what is unknown and untested in RFID-based proximity bracelets for Attendance Monitoring Systems.

### *Radio-frequency identification (RFID) Technology*

Shifting from the manual collection of attendance to the automated attendance management system was done through the usage of Radio-frequency identification (RFID) technology in the research of Bhandari, Jain, and Amrutia (2014). With the use of RFID technology, the system requires hardware and software components. In this project, the hardware was a ready-to-buy basic scanner to be used in reading the data embedded in the RFID card. The RFID card will be used by the students to take attendance. It has a unique 10-digit code that contains the student's information and identity.

As for the software component, it is a web-based application server that holds the database of the system. The server will be activated once the RFID card is read by the *RFID scanner*. After the card is read, the database will record the attendance of that student. The MS SQL Server is the application being used for the system's database while the server itself contains the codes for the design of the website and the actual code itself. The educators and administrators, named as "Client", can also access the records of attendances in the database. They will only see the actual website through a browser.

The attendance management system with the use of RFID technology was deemed as a successful project by Bhandari, et. al. (2014). Due to the efficiency

of the project, it has provided a convenient way to record attendances as opposed to manual recording. The web-based software system incorporated can be accessed easily due to its user-friendly interface. This software system has served as a basis for the software structure to be used in the RFID Proximity Bracelet.

### *Radio Frequency Identification (RFID) system*

Chiagozi, et.al (2012) emphasized the use of RFID, describing it as a mature technology designed to automate systems. RFID has developed rapidly in recent decades in response to the need from modern industry for data accuracy and system efficiency improvements. RFID reader and RFID tags are supporting components of this electronic equipment, with a variety of tags manufactured to satisfy industry needs. RFID system is widely applied in various sectors, notably in education, transportation, agriculture, animal husbandry, retail sales, and other sectors. Student attendance monitoring system is one application of RFID in education. The RFID system allows you to track the movements of tagged users, record real-time data, and send it to a processing system to keep a log. The system is comprehensive, effective, and efficient ergo, it can assist in the automation of student administration.

The study conducted by Shinde and Shaikh (2017), monitors the attendance of the students by utilizing the RFID for administration. If students and faculty are absent from class, notification will be sent to parents as well as the school's administration through GSM. GSM (Global System for Mobile Communications) is used to notify parents of students who are absent from class.

While, in the study of Farid and Irawan (2018), the utilization of RFID in student attendance monitoring system by using Internet of Things (IoT) and Cloud technology to create a real-time attendance monitoring system that can be accessible by a variety of parties including lecturers, campus administration, and parents. The web-based attendance management system has the advantage of keeping track of attendance accessible to the academic institution's top administration in the form of detailed, summary, and Reports of exceptions. Though, in this system, students have barcodes printed on their student cards, which are read by a barcode reader when students present them. This presence is efficient and affordable; however, the system lacks security in such a way that barcodes can be simply copied by printing them on an ordinary printer (Adriantantri, 2019).

Schapranow et al. (2007) conducted a study to show one of RFID technology's major drawbacks: security. The security flaws in RFID technology make it easy for hackers to hack the system. RFID technology has been used in a variety of attacks, including man-in-the-middle, RFID cloning, spoofing, and replay attacks. Controlled signal interferences and data encryption methods can reduce RFID technology's vulnerability. Curtin et al. (2010) propose a research agenda to resolve a series of broad research questions about how RFID technology is developed, adopted, and implemented by different sectors, how it is used, supported, and advanced inside organizations and sectors.

### *School Bus Security System Based on RFID and GSM Technologies*

School bus services have a vital role in the means of transportation for students, as these services provide safer and faster transportation from a student's home to their respective school. Many parents rely heavily on school bus services, despite their concerns about their children's safety. According to statistics from the National Crime Bureau (2018), a child is abducted every eight minutes. As a result of this difficulty, the study of Mansor et al. (2020) presented an SMS-based solution to help most parents track their children's school bus movements (in/out). The study's purpose is to develop a school bus security system that uses RFID and Global System for Mobile communication (GSM) technology to ensure a secure system that eliminates any harm and danger that can be inflicted on children while on the bus. Relying on identifying the unique identification information of the RFID technology, the suggested system keeps track of every student's entry and exit. Parents will receive an SMS once their children have boarded the bus and arrived at their destination.

RFID is utilized to match the student's identification to the parent's phone number and to count the number of students, whilst GSM is used as a platform to send SMS notifications to parents about their children's whereabouts (Fadzir et al., 2018). The overall performance of the researcher's RFID system has been put to the test. According to such results, the project created can provide a real-time message system to parents on their children's whereabouts, as well as a student attendance checker. In conclusion, most parents who entrust their children to the school bus system may find this

prototype system to be reassuring. The research of Krishnan and Vasuki (2019) pointed out that the success of the suggested RFID system model on bus services can be evaluated in the long term based on the preventative measures of abduction crime activities among school-aged children.

#### *School library system using Arduino Uno and RFID RC-522*

In the school library of SMK Sultan Badlishah, as shared by Raman (2020), the RFID School Library System created with the Arduino IDE, an RFID reader and card, an Arduino Uno, Microsoft Visual Studio, and MySQL, is a system that uses a technique for librarians to scan students' library cards throughout every book borrowing procedure. The project was created since there is no automated system in the library, therefore librarians must still use a manual handwritten method, which takes a long time to complete. Furthermore, there was no security aspect because they simply stored the data of all borrowed books in the logbook. Additionally, the number of lost books loaned by students grows every year, to the point that even librarians are unaware of it. As a result, the project is being developed to transform laborious handwritten data input into an RFID system for data dependability and to allow librarians to work more effectively. The goal of the security system should be to offer a safe and secure environment for library personnel, library resources and equipment, and library patrons for security purposes. Furthermore, due to the implementation of a security system, which promises to boost efficiency and production to further improve user satisfaction (Molnar & Wagner, 2016). The project's goals are to create an RFID-based school



library system and assess its functioning with users. This project included four types of testing: functionality, network, user acceptability, and test case.

In a study made on the Saint Louis University (SLU) in the Philippines by Swedberg (2018), the school's library utilizes an RFID system using an Arduino Uno which the reader at the door catches the ID numbers of all books, even if they are stacked closely together, and sends the information to the ClearStream RFID middleware, which interprets it and sends it to the library's administration software. If the software detects that any of the goods have not been checked out, an alert is presented at that place, and the user is prompted to check them out. The status of the resources having been removed can be updated using the software. When a book is returned, an RFID scanner at the library's circulation desk interrogates its tag ID and updates the book's status to "received," allowing it to be placed back on the shelf. The use of RFID in library sections improves the borrowing speed of books, as well as the monitoring speed and the speed with which the process of book searching is completed (Chamola & Sharma, 2015). The research of Boss (2017) complements the use of RFID tags using RFID RC-522 that can be found on some library facilities. It may replace or supplement the barcode, providing a new way for workers to control inventory and for customers to self-serve. It can also be used as a security device, replacing the conventional electromagnetic security strip.

*Lack of security and safety (Problem Encountered)*

The use of RFID for the attendance system in schools is proven to have its advantages, however, with the use of such complex technology, disadvantages would still pose a threat such as cases of invasion of data privacy that could threaten the security and safety of each student. According to the research of Beggal and Azizi (2017), the immense complexity of the Radio Frequency Identification (RFID) does not guarantee fully secure confidentiality of data to its users, as cyberattacks such as cloning, and tracking could particularly invade the user's privacy by hacking to the server of the technology. Ema and Fujigaki (2013) draw implications from a case done in Japan that involves monitoring a child, in which the parents of the child are being informed of the children's exact location but cannot guarantee their actual safety, but RFID tags often lead to that cherished illusion without the knowledge of an invasion of privacy. The study of Ball et al. (2012), states that the use of RFID technology in schools brings a lot of concern for the parents of the students as officers of the law could force the school in giving up the privacy of a student for the sake of surveillance, which in turn invade the right of the students to have privacy.

Privacy is the most important concern RFID users have to deal with (Jung & Lee, 2015). RFID tag embedded chips often contain important personal information and usually, this kind of private information can hurt one's privacy seriously if leaked. Ohkubo et al. (2015) pointed out in their study that anyone can read the link between the product and the tag, which in turn gains information about the tagged contents or data of a person without being aware of such invasion if a

generic naive RFID system is employed. By viewing tags without sufficient access restriction, unauthorized readers may jeopardize privacy. Individuals may be traced by predictable tag responses, even if tag contents are protected; this is effectively a traffic analysis assault that violates "location privacy" (Weis et al., 2018). Individuals who carry objects with insecure tags are at risk of having their privacy violated. The contents of a person's pockets or bag could be scanned by a nearby eavesdropper, providing useful information to inquisitive neighbors, market researchers, or robbers looking for easy prey (Talidou, 2016).

#### *GPRS function (System Development Tools)*

The security and privacy of an RFID technology are one of the most vulnerable parts of the system in which it could be easily attacked by hackers, it is in the utmost importance of a researcher to provide an RFID technology that ensures a secured data storage of its users. According to Rahman et al. (2019), for an RFID to work flawlessly while ensuring a secured and safe system, the use of the GPRS function of the GSM module to store data in the cloud database is a vital aspect of the development of the technology to repel any cyberattacks. It can also be made more secure by adding a CCTV camera to the technology. In the study of Vidyagar et al. (2015), a global system for mobile communication (GSM) is used for their RFID system to communicate with the parents and to the school principal. The mode of data transmission is through SMS only to avoid any data privacy invasion, a microcontroller will communicate with the GSM modem serially via MAX 232 Line driver to provide added security. A study also suggests the use of an RFID Guardian, it is a compact, portable, electronic device that can locate,

record, and display all RFID tags and scans in the area, it manages RFID keys, authenticates nearby RFID readers, and prevents unauthorized readers from accessing the user's RFID tags and data that combat any possible hackers (Rieback et al., 2015).

Hedefine (2016) conducted a study that uses the advantage of kill code for a far more vast and complex security for the RFID system, it utilizes encryption is employed to kill a tag. Research by Wang (2014) has shown that the use of cover coding can greatly increase the chances of repelling cyberattacks on any RFID system, a reader's signal is louder than a tag's, making it easier for outsiders to pick up its transmissions. It is also evident that the usage of a lock password in an RFID system is also one way to ensure data privacy, in which a 32-bit password with over 4 billion possible combinations must be transmitted before a tag will transmit its data, skimmers will be unable to access the data due to the high security (Azura et al., 2012). A research study by Jaykumar and Blessy (2014) proposed an IOT-based 'Smart Environment' scenario that based on RFID, has a "Kill Password" and "Access Password" approach to provide authentication, data confidentiality, and data integrity at the various levels of communication.

### **Related System**

This part of the paper will present the five (5) related systems associated with the research project. This section comprises of patented studies and systems within the last fifty years from other countries that illustrate the key features, usefulness, beneficiaries, and materials used in the development of the system.

The related system of the study is divided into five (5) systems Campus Attendance System, Remote RFID Attendance System, Jianhwa P., Ying H., Chao L., (2019), Wang (2017). Attendance Tracking System, Dobson, et. al. (2004); and RFID Bracelet and Method for Manufacturing a RFID Bracelet, Singleton (2007);

**Wang (2017), Campus Attendance System, CN206805641U**

The system was invented in China. The traditional student attendance checking takes a lot of time and effort that may result in inefficient and inaccurate attendance data. According to Wang (2017) in order to solve the problem, the invented utility model relates to an identification technique field that specifically adopts the accuracy and efficiency of gathering student's attendance. The system model provides a campus attendance system which sets up a dual information collection channel to ensure the accuracy of attendance information. Meanwhile, the student card is utilized as a radio frequency receiving device.

The attendance system includes an attendance server, a main attendance terminal, a number of sub-attendance terminals and the usage student cards. The main attendance terminal contains the database of student identity information. It also serves as a radio frequency transmitter arranged on the campus entrance. The radio frequency transmitter will transmit a radio frequency signal through a radio frequency transmit antenna. Thus, the student card comprises a memory storing identity information of the student card user, a radio frequency receiving circuit, a GPRS wireless communication module which are all connected to a microprocessor. The circuit will receive the radio frequency signal sent to the

microprocessor; it will then receive the signal from the memory to retrieve student identity information. The GPRS wireless communication module is sent to the attendance server thus, the sub-attendance terminal is arranged in each classroom.

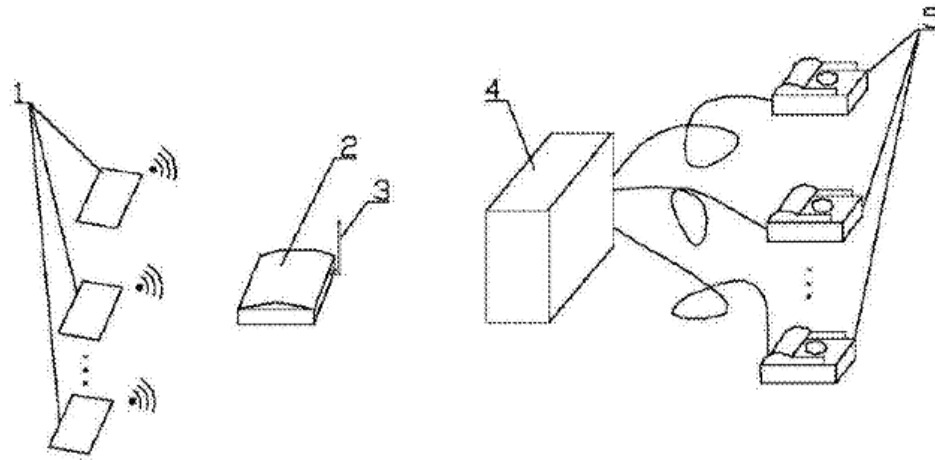


Figure 1. Wang (2017), Campus Attendance System, CN206805641U

**Jianhwa P., Ying H., Chao L., (2019), Remote RFID Attendance System  
CN208569713U**

Remote RFID attendance system an invention created by Pang Jianhua, Han Ying, Liu Chao of Shine Tech Co LTD, Beijing, China. This invention relates to the use of a remote RFID attendance system that reads the information on an RFID attendance card to provide a remote RFID attendance system. This attendance system makes use of an RFID reading device to read the information on the RFID attendance card, as well as to keep track of, manage, and store the data. Because of its capabilities, this invention relates to our RDIF bracelets, which read information that is being sent to the management server to achieve automatic

attendance for students or employees. This is especially true in the case of a long-range RFID time and attendance system.

A long-distance RFID time and attendance system are provided by the utility a second card body having a rectangular parallelepiped structure are disposed of in the card slot, a side of the second card body is provided with a card pocket, and the card pocket is provided with an RFID electronic tag, The connecting member includes a connecting plate, one side of the connecting plate is provided with an adhesive layer, and the other side is connected with a connecting column perpendicular to the connecting plate, and the end of the connecting post passes through the first damping shaft and The first damper shaft is rotatably coupled. model, which includes an RFID timecard, an RFID reading device, and a management server. The first card body is a rectangular parallelepiped structure, and the corresponding two sidewalls of the first card body are respectively provided with a set of lugs and a card slot. The first damping shaft is fixedly connected between the two card ears. The opening of the card slot passes through a second damper hinge is hinged with a card cover, the first damping shaft is fixedly connected between the two card ears, and the first damping shaft is fixedly connected between the two cards. The connecting member includes a connecting plate, one side of which is provided with an adhesive layer, and the other side relates to a connecting column perpendicular to the connecting plate and the end of the connecting.

The RFID timecard offered in the utility model's remote RFID time and attendance system can be attached to the items carried by the student/employee

according to his or her needs, for example, to the bag or the mobile phone. On the one hand, it is difficult to lose, and the timecard offered by the utility model has two card body structures, with the RFID electronic tag being placed in the card pocket of the second card body, making it easy to replace and carry. The given RFID card cannot be easily lost due to its efficiency. The staff could benefit from this and keep track of student/employee attendance in a systematic manner. The use of a remote RFID attendance system is beneficial in school and classroom settings when custodians are monitoring students/employees.

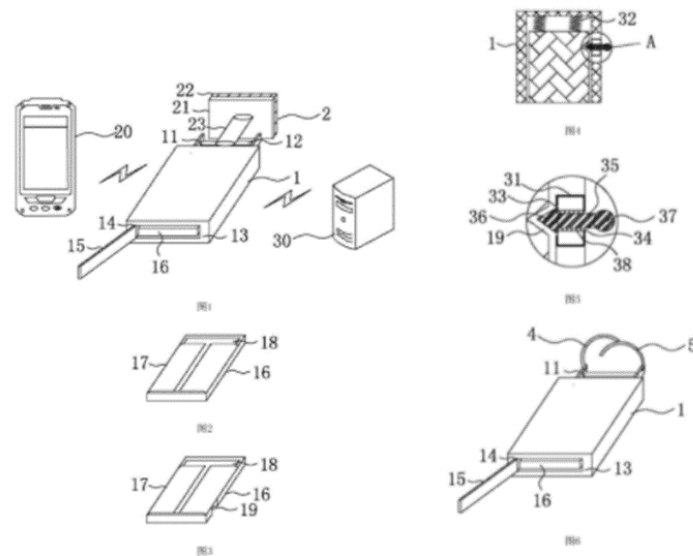


Figure 2. Jianhwa P., Ying H., Chao L., (2019), Remote RFID Attendance System  
CN208569713U

**Dobson, et. al. (2004), Attendance Tracking System, US8353705B2**

Attendance Tracking System, an invention by Michael Dobson, Douglas Ahlers, and Bernie DiDario who are based in the United States of America, is an



automated attendance monitoring system. The system incorporates RFID technology through wireless identification tags which will be read by scanners and further recorded by the software to its database. The concept of the attendance tracking system is favorable towards school and classroom settings during the attendance of students. Through its high efficiency, not only the seamless attendance can benefit the students, but also the teachers, making more time for class discussions. The data placed in the database will be monitored which can enable the educators to see the attendance of students.

RFID chips filled with the student's information will be embedded in the students' physical identification cards which will be scanned by RFID scanners. The chips that will be used can only be read by the specific scanners present on the school premises to ensure the safety of the student's identity. The RFID scanner used in this invention is a Matrics AR 400 wireless scanner which is powered by a 24-volt DC with 1.2 amps. This scanner has a software-based computer system network device called Matrics Visibility Manager which serves as a means of communication between the RFID scanner and the tags. The scanned data will later be sent into the database in the server which will be interpreted based on the programmed set-up of records. The server may be placed on any computing device that is suitable for the system. Handheld computing devices are also used by the teachers in case of errors in the attendance of the students at a real time scenario. The software employed may use developmental tools like Visual Basic, Access, and ODBC which can cooperate with student information systems like SASI, Aeris, and PowerSchool.

The researchers are deeply influenced by the wireless and efficient system that is presented in the invention. With this, the researchers will also integrate the RFID technology to make an attendance system for students through proximity bracelets as opposed to the invention's ID tags. The proximity bracelets can be read certain distances presented in the proximity sensor by RFID scanners as opposed to having the ID tags to touch the RFID scanners in the invention. As for the software, the concept will be the same but with the usage of different applications that are presented in the invention.

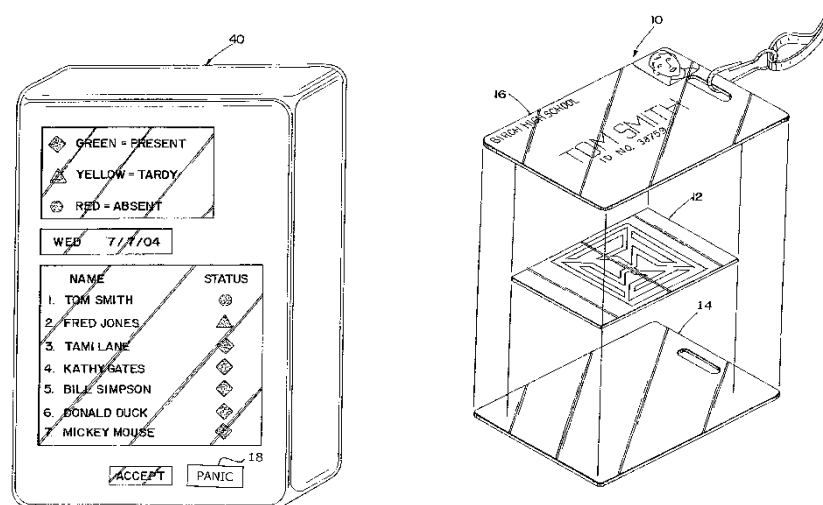


Figure 3. Dobson, et. al. (2004), Attendance Tracking System, US8353705B2

### Housley S., Housley G., (2012), Proximity Tracking System

**US2015035672A1**

Proximity Tracking System, created by Housley Shannon and Hously Glenda of the United States of America refers to a proximity tracking system. This invention relates to our RFID bracelet by its use of automated wearable tracking

device that emits sensory indications at a specified distance from a monitoring wearable device, such as modified bracelet. This system incorporates the RFID technology through a wireless tracking system to a battery powered custodian component which configures to communicate wirelessly with one another to determine their relative proximity. The main concept of this proximity tracking system is targeted towards a specific demographic, favorable towards school personnel such as teachers, principals, guidance counsellors and can be used in monitoring the attendance of students. This system contains a set of commands features and is battery powered to make the use of this much more efficient for the wearer and the custodian.

The custodian wears a battery-powered custodian component, which is defined in one embodiment as a monitoring bracelet with a set of command features, and the child wears a similar battery-powered child component, which is defined in one embodiment as a bracelet. The communications technology specifies a wireless data transmission protocol that allows for both real-time distance measurement and real-time data transfer from the tracking device. The preferred embodiment's communications technology combines space-based satellite navigation technology, known as the Global Positioning System ("GPS"), with wireless personal area network technology to enable real-time wireless communication between the devices. In the recommended implementation, the custodian component allows a user to select one of three pre-determined distances at which its alerting features are activated: 15 feet, 30 feet, or 50 feet. As a result, when a person wearing the kid component approaches the custodian

component at the predetermined distance, the child component will start flashing lights and emitting an audible alarm to alert the custodian.

The method has been impacted by the invention's wireless tracking capabilities, which provide an effective manner of controlling pupils and employees. The researchers will use this to link the invention with an attendance monitoring system that scans and records the software in a database. This will navigate to a spot where the custodian is within range of its distance using a proximity tracking device. Whether a member of the school staff or a student has entered the school promises, this will identify the custodian.

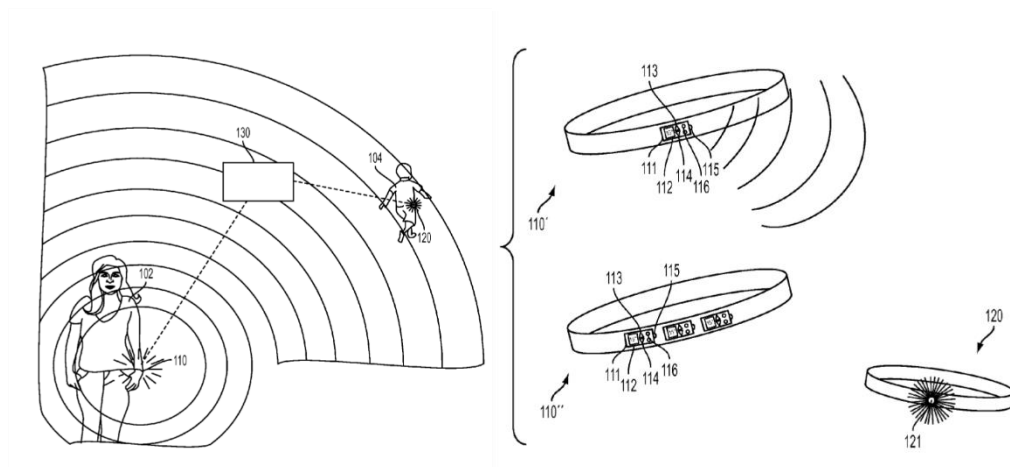


Figure 4. Housley S., Housley G., (2012), *Proximity Tracking System*

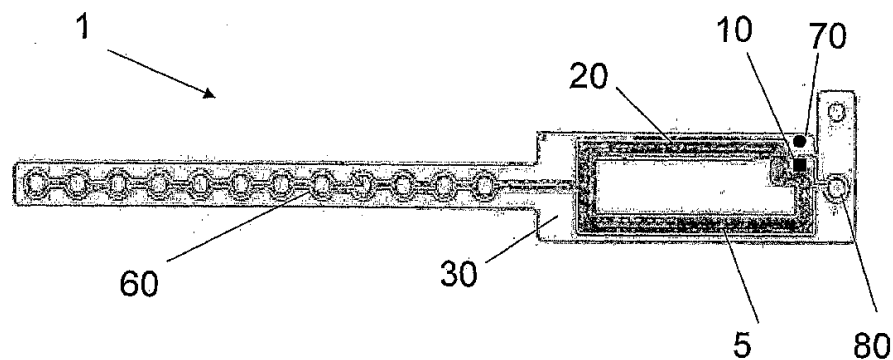
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### **Singleton (2007), A RFID Bracelet and Method for Manufacturing a RFID Bracelet, WO2007011514**

The system was invented in United States of America. Bracelets can have numerous applications from functional to fashionable, as bracelets might be used as a ticket to indicate that the wearer is eligible to access a location or concert

(Singleton, 2007). Radio frequency identification (RFID) chips may be incorporated into bracelets to give them increased functionality. Generally, the network system may track an item with an RFID chip and therefore identify the location of the RFID chip as well as the user of the RFID bracelet.

The embodiment of the invention relates to a bracelet comprising a (1) bottom layer having a top surface and a bottom surface, (2) a radio frequency identification microprocessor attached to the top surface of the bottom layer, (3) an antenna; operably coupled to the radio frequency identification microprocessor and attached to the top surface of the bottom layer, (4) a core layer; positioned above and is attached at the bottom layer. In conclusion, the mentioned parts which are the radio frequency identification microprocessor, the antenna and the top layer are positioned above and are attached to the core layer, Singleton (2007).



*Figure 5. Singleton (2007), A RFID Bracelet and Method for Manufacturing a RFID Bracelet, WO2007011514*

## **Theoretical Framework**

This part of the paper will discuss important theories to strengthen the advancement of this project. This research will utilize two theories: Data Quality – Theory to Practice introduced by Al Hakim and Pareto Principle (80-20 Rule) by Vilfredo Pareto

### *Data Quality – Theory to Practice*

The data quality introduced by Al Hakim emphasized that to ensure the credibility of data, it must be evaluated and measured. Data quality is the evaluation of data based on various factors (Fan, 2007). According to Al Hakim (2009), as cited by Heinrich and Klier (2010), executives only perform well when high-quality data is available. Furthermore, they devote more time to fact-checking data that they have gathered to ensure credible results and records. These are the following factors: (1) data consistency, (2) data duplication, (3) information completeness, (4) data currency, and (5) data accuracy (Fan, 2007).

To begin, data consistency refers to the authenticity of the data in order to detect errors within the collected data. (Fan, 2007) Chen et al. (2020) created a Data Consistency Assessment Function (DCAF) to test the entire data set's consistency. Data deduplication is a storage-saving technique that involves matching, linking, and identifying tuples in a data set to identify identical data in order to combine and improve the information collected (Fan, 2007; Meister, et al., 2012). Information completeness assesses the collected information in terms of its completeness and ability to answer queries. Furthermore, data currency refers to whether or not the data is up to date as indicated by timestamps (Fan, 2007).

Finally, data accuracy is an important metric for measuring data quality because it indicates the credibility and dependability of the source from which the data was obtained (Fan, 2007).

An attendance monitoring system is used to collect data on students' and staff's presence and absence over a set period of time. According to Nawaz et al. (2009), attendance records are critical in management but difficult to manage and maintain, making them inefficient. There are issues with manual checking, such as data tampering, which occur frequently (Patel, et al., 2012). Students are easily able to falsify their attendance records (Cronjé and Sanders, 2021). As a result, data quality must be carefully considered and verified. Using an RFID system to collect attendance records for a large number of people over a long period of time—automatically, it is sent and recorded in its database and is easier to manage than traditional paper-based data collection systems.

#### *Pareto Principle (80-20 Rule)*

Time management in the classroom is needed to help both parties, student and teacher, to become more productive in class. The Pareto Principle is a theory devised by Vilfredo Pareto (1848-1923) as he observed the uneven distribution of land and wealth in Italy. He discovered that 80% of Italy's wealth come from 20% of the population (California State University Northridge, n.d.). Generally, it states that 80% of the results come from 20% of the causes. It can be a reference for people to determine the causes of certain consequences in their businesses

(Investopedia Team, 2020). Although it is derived from an economic point of view, it can also be used in different situations (Alecu, 2010).

Since the study revolves around time management in the classroom, specifically with attendance monitoring and making it more efficient for the teachers and students, realizing the time distribution for tasks is needed. Applying the theory, if 20% of the used time for checking attendance is decreased then, 80% of the productivity in class can be increased. Therefore, this study is applicable and relevant in identifying the efficiency of utilizing time in checking attendance through RFID based proximity bracelet.

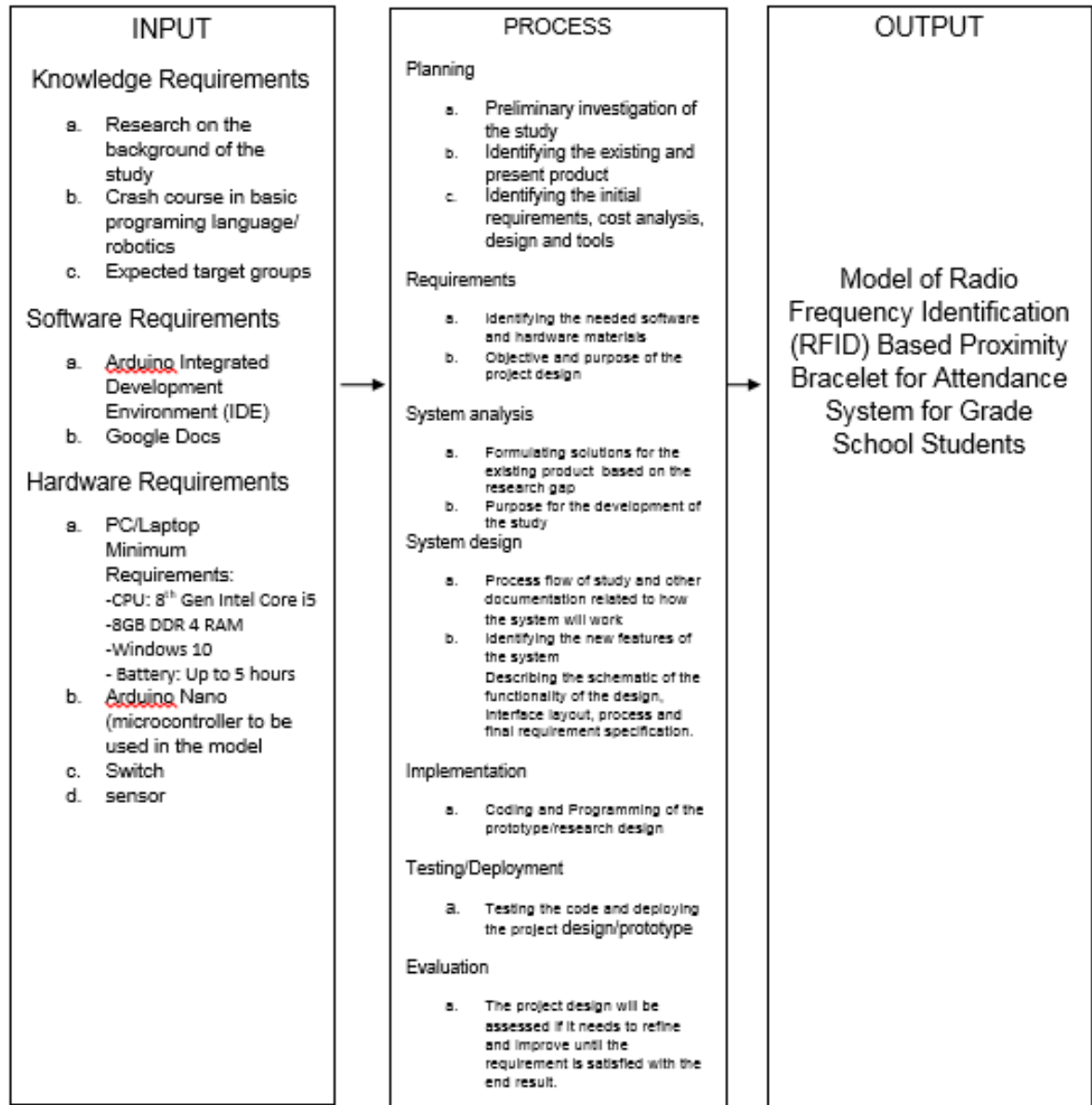
These theories show that innovation and technology help the conventional methods efficient. Integrating the RFID system in monitoring the attendance of the students does not only minimize the time consumes, but also helps to secure the data quality.

### **Conceptual Framework**

This project will be utilizing the Input Process Output (IPO) Model as its conceptual framework. The IPO framework will represent the developer's synthesis of the literature in mapping out the development of this research project. There will be three main parts to this model input, process, and output. In general, three factors in the input must be met: knowledge, software, and hardware. The developers will undergo the study once these requirements are satisfied. A series of steps are assigned throughout the process to ensure that the project runs well,



and that the timeline remains controlled. Lastly, the output where the concepts and process of the study finally aim the project objective.



*Figure 6. Conceptual Framework for Project design of Radio Frequency Identification (RFID) Based Proximity Bracelet for Attendance System for Grade School Students*

The developers must consider the input before they begin the product which includes the knowledge, software, and hardware requirements. First, they should gather initial data about the topic of interest to fully understand the project's objectives. Ergo, it is important to research the background of the study, the product's target users, and their expectations. In addition, programming/coding skills are crucial in creating the desired device as it involves formulating codes that will allow it to effectively perform its functions. Furthermore, the software requirements that consist of Arduino Integrated Development Environment (IDE) and Google document must be installed in the developer's laptops to plan the project. Lastly, the hardware requirements are also considered to utilize in making the research project. The developers will move forward with the process of designing RFID-based proximity bracelets after these prerequisites are accomplished.

To begin the designing process, more specific research on the actual product's concept, existing products for product references, initial requirements like the design and tools as well as their cost analysis will be needed to have further information about the project. This will help in identifying the project's hardware and software requirements aiding the formation of the project design and its function. With its identification, the researchers will start on the analysis of the product's system. Determining the solutions for existing products' research gap detects the possible changes and development of the project and its purpose. After the analysis, the overall system design of the product will be created. It features the workflow of the system, the documentation of each workflow, the system's new

components, and the purpose and functionality of the whole design. With the system design ready, the product's implementation of the system comes afterward through coding and programming.

Since the system has been implemented, the researchers will proceed into testing the code and deploying the project design or prototype. Through this, they can start evaluating the project design or prototype with its functionality. As it is being assessed, the researchers may be able to further refine aspects of the design or prototype until further satisfaction. With all the processes finished, the researchers will arrive with the final output for their research project. The final output will be the "Project Design of Radio Frequency Identification (RFID) Based Proximity Bracelet for Attendance System for Grade School Students".

### **Operational Definition of Terms**

For a better understanding of this study, the following terms are defined in the context of capstone research:

Attendance system- It allows monitoring the exact arrival time of each student and automatically alert parents in case of a student's absence.

Radio-Frequency Identification (RFID) - Radio-frequency Identification uses electromagnetic fields to automatically identify and track people or objects using tags. RFID is the mode of the transfer of data from one module to the other.

Proximity Switch- A proximity switch is used to determine how close an object is, or the proximity of an object. This tool's significance is to determine the student's range parameter.

NRF24L01 - is a wireless transceiver module, wherein each NRF module can both send as well as receive data. The module's significance to the study lies in its ability to send and receive data wirelessly.

Real Time Clock (RTC) module - RTC modules are simply TIME and DATE remembering systems which have a battery setup wherein with the absence of external power like batteries keep the module running. This module's purpose to the study is to keep time and date up to speed for logging the student's whereabouts within school campuses.

Arduino - Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices which are small computing systems. The arduino is the backbone of the product as it serves as the main controller for the system.

SD Card – a small card for creating and storing memory on digital devices like cell phones or other portable devices. The SD card's significance is to store the data being transmitted from the sender to the receiver.

## **CHAPTER 3**

### **METHODOLOGY**

This chapter will present the reliability and validity of the study. This section contains the discussions of the research design, process model, research participants, and setting of the study. It will further illustrate the research design and the process model used in this study to elucidate the project's system/model. In addition, this chapter will discuss tools used by the developer, the assessment tool used to gather the data from the participants, and the software and hardware tools used in the study in the system development tools. The data collection procedure of the study will also scrutinize to show the process of how the data will be collected. Lastly, the study's trustworthiness, along with the ethical considerations that the proponents recognize while conducting the study will be presented.

#### **Research Design and Process Model**

This capstone research project will use a qualitative research design. Qualitative research is multimethod in design and takes an interpretative, naturalistic approach to its subject. This means qualitative researchers explore phenomena in their natural settings, aiming to understand or interpret occurrences in terms of the meanings people attribute to them (Lincoln, 2005). Furthermore, qualitative research is like an iteration in which a specific community gains a better understanding by developing new significant distinctions as a result of getting

closer to the phenomenon studied (Aspers, 2019). Qualitative research is a type of systematic empirical inquiry into meaning. Systematic which implies organized, ordered, and public. Empirical indicates a form of inquiry is based on personal experience (Shank, 2002). This can help the developer's product improve because the participants may provide useful suggestions and solutions for troubleshooting the device's issues. As a result, this study will utilize qualitative research because this method is well suited to the study as it can help avoid costly project errors in the future (Becker, 2017).

In addition, the method to be used by the developers for this project will be the Iterative Process Model. It is the chosen method as it is the most efficient for the developers' capstone research. An iterative model allows the developers to create, test, and revise until they are satisfied with the product's goals. The iterative process begins with a basic implementation of the initial software requirements and iteratively enhances the versions until the full system is complete. Design changes are made, and new functional capabilities are added with each iteration. Every phase will be guided by the industry experts. The primary idea behind this process is to build a system in little portions over time. The iterative model is like a trial-and-error methodology that brings the developer's project closer to its end goal (Martins, 2021). The process involves planning, requirements, analysis and design, implementation, deployment, testing, and evaluation.

*Initial Planning.* The process begins with the preliminary assessment of the whole project and its main concept.

*Planning.* After the initial assessment, the developers will specify the project's objectives, initial requirements, cost analysis and scope.

*Requirements.* This step identifies the software and hardware requirements needed. Moreover, it includes the purpose and objective of the project design.

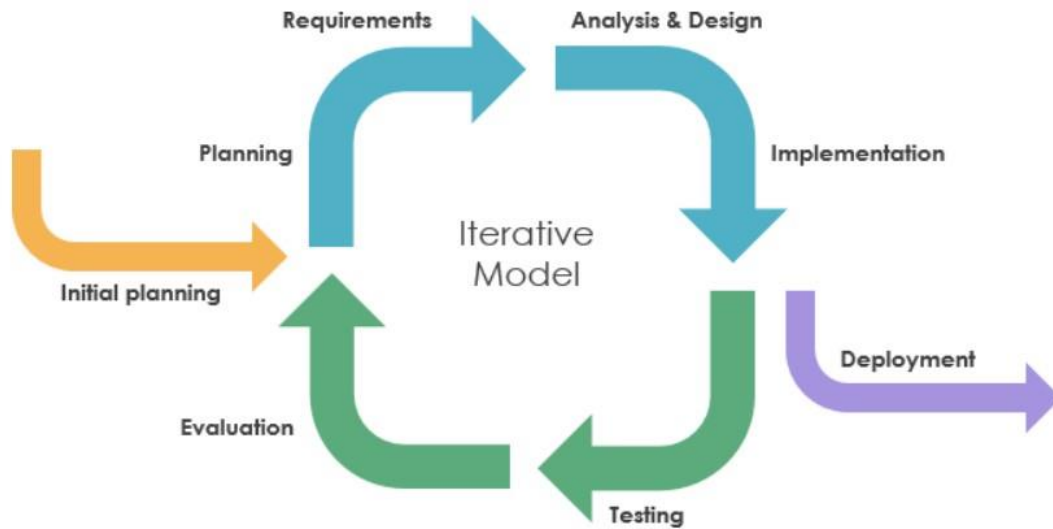
*Analysis and Design.* The requirements and its design specifications will be established and analyzed to understand what the developed final model will be. In addition, in this stage the developers will be guided by the industry experts for the development of the product.

*Implementation and Coding.* All previous planning with industry experts including the programming and coding of the prototype/research design will be put into action during this step.

*Testing.* After the implementation and coding, testing will be performed to ensure that there are no other errors. In this stage, the developers will do the testing with the industry experts to identify the errors of the system. If there are such errors and bugs, then the project's design will be amended and reworked. Still, with the guidance and help of the industry experts.

*Evaluation.* In this stage, the focus group discussion (FGD) with the industry experts and the developers will transpire. The project design will be assessed to see if it needs to be refined and improved until the end result meets the requirements

*Deployment.* The project's design/ prototype will be deployed and will be ready for usage.



*Figure 7. Iterative Process Model*

## Research Locale

The study will be conducted in region 11 Davao City, Davao del Sur. Davao City is a coastal commercial city on the southern Philippine island of Mindanao, near Mount Apo, the country's highest peak at 2,954 meters. The developers chose to conduct their study in this locale because the information and participants needed in the study are found in the city. The study will be conducted during the second semester of the Academic Year 2021-2022 of Malayan Colleges of Mindanao.





*Figure 8. Map of Davao City, Davao Region, Philippines*

## Research Participants

The participants of this study are the different industry experts in the locality of Davao. The study will consist of skilled and adept industry experts in design development and the product. The total sample size of participants will be six (6) industry experts. The selection of participants will be made through the utilization of the purposive sampling technique. This is a non-probability sampling technique that is chosen based on characteristics population and study's objectives. Purposive sampling entails selecting individuals who are experienced or educated about the study's intention (Crossman, 2020).

The chosen participants who will serve as the primary source of data will be selected under certain considerations:

- a. (2) System Engineers – Must be a resident of Davao City who is professional in developing, testing, and maintaining complex systems. They must

also guide on the project system to guarantee that the project's requirements are achieved. Also, he/she is willing to participate in the study.

b. (2) Software Engineers – Must be a resident of Davao City who is professional in developing, designing and testing, software projects. They can monitor the functionality and performance of the invention by conducting tests and maintenance. Also, he/she is willing to participate in the study.

c. (2) Hardware Engineers – Must be a resident of Davao City who is professional in designing, developing, testing, and producing computer systems and various physical components related to computer systems. Also, he/she is willing to participate in the study.

### **Research Assessment Tool**

To assess the product, the researchers will need to gather data through the usage of a research assessment tool. The assessment tool to be used will be an open-ended research questionnaire. The questionnaire will be utilizing the FURPS+ type of research assessment tool to assess the RFID-based proximity bracelet for attendance system for grade school students. Through the FURPS+, the research participants will assess the product's functional and non-functional requirements by their Functionality, Usability, Reliability, Performance, and Supportability. (PSPlus, 2017). The functional requirements refer to the features that are intended for the creation of the product by the researchers. These are the main functions and features of the product. Non-functional requirements, on the other hand, refer to the “quality constraints” of the product. (GeeksforGeeks, 2020).

However, to answer the project objectives of this research, the researchers will only include the Functionality, Reliability, and Performance of the product for the assessment.

An open-ended questionnaire will be answered by the research participants. The chosen participants who are industry experts in design development will be the ones to assess and provide feedback on the product's flaws. Furthermore, the assessment tool to be used will be validated beforehand to have credible results.

### **System Development Tools**

This section of the paper will present the software and hardware tools used in the study. The developers will use these tools to create an RFID-based proximity bracelet. The software tool which is Arduino IDE will be the primary software used to program the system. The hardware tools are sensors, modules, and Arduino nano which make the project's model possible.

<b>Development Tool</b>	<b>Description</b>	<b>Function</b>
Arduino Nano	The Arduino Nano is a compact, open-source electronic development board based on an 8-bit AVR microprocessor interoperable with other Arduino boards. This board has two variations:	It's utilized to make a clock with a precise frequency by employing a continuous voltage source. The ATmega328 microprocessor used in the Nano board supports

	one based on the ATmega328p and the other on the Atmega168.	serial connection (UART TTL). This is accessible via digital pins such as TX and RX. A serial monitor is included in the Arduino program that sends and receives textual data from the board.
Arduino Software Integrated Development Environment	It is an open-source software developed by Arduino.cc that may be used to write, build, and upload code to almost any Arduino Module.	When a user writes code and compiles it, the IDE produces a Hex file. (A Hex file is a Hexa Decimal file that Arduino can understand) and then transferred to the board via USB wire. Every Arduino board has a microcontroller built-in; the microcontroller receives the hex file and executes the code as written.

NRF24L01 Modules	It's a wireless transceiver module, which means each one may send and receive data. They operate at a frequency of 2.4GHz, which is part of the ISM band and so allowed to be used for engineering purposes in practically all nations.	It uses radio waves to work. These modules also use the 2.4GHz frequency to communicate and receive data between the Arduino board and the module, and they use the SPI communication technique to do so.
RTC module	The term "RTC" refers to a real-time clock, an electronic device that keeps track of time. The RTC module combines the RTC IC, oscillator circuit, and master clock into a single package. You don't have to build your oscillator or change the frequency.	Even when the system is shut off, it saves time. As a result, an RTC can be used as a trigger to switch on a system in situations such as alarm clocks or mobile device scheduled power.
SD Card Module	It is a non-volatile memory card format created by the SD	It can store vast volumes of data and is commonly used in mobile devices

	Association (SDA) for portable devices.	such as cameras and smartphones, and it has the potential to save lives in specific scenarios.
RFID Technology	Radio Frequency Identification, or RFID, is a wireless technology consisting of tags and readers. The reader is a device that generates radio waves and uses one or more antennas to receive signals from the RFID tag.	AIDC (Automatic Identification and Data Gather) methods recognize items automatically, capture data about them, and enter that data into computer systems. RFID is part of this category of technologies. An integrated circuit and an antenna are included in RFID tags, used to transmit data.
Proximity Switch/Sensor	Proximity sensors can sense the presence of items nearby without making physical touch. They work by producing an electromagnetic	It is utilized in a variety of manufacturing operations. Some are used to detect the opening of a door by

	field, which the proximity sensor detects when it changes.	measuring the position of machine components, security systems, and other applications. Robotics is another use where they may notice the proximity of a robot or its features to things and direct it accordingly.
WiFi Module	WiFi (wireless fidelity) modules, also known as WLAN (wireless local area network) modules, are electronic components that enable a wireless connection to the internet in various goods.	The function is to transform a serial port or TTL level into an embedded module that complies with the WiFi wireless network communication standard and includes a wireless network protocol IEEE802.11 B.G.N protocol stack and a TCP/IP protocol stack.

*Table 1. System Development Tools*

The researchers will need the tools listed above to create an RFID-based proximity bracelet. The Arduino Nano is a small microcontroller that can generate a precise frequency. The Arduino Software Integrated Development Environment, on the other hand, is open-source software that allows you to develop and compile code. The NRF24L01 Modules is a wireless transceiver module that communicates and receives data between the Arduino board and the module using radio waves and the 2.4GHz band. The RTC module is an electrical gadget that helps developers save time by keeping time. The SD Card Modules is a non-volatile memory card format that stores large amounts of data. RFID (Radio Frequency Identification) is a tag-based wireless technology and readers recognize goods automatically, collect information about them and enter it into computer systems. The Proximity Switch/Sensor detects the presence of objects nearby without requiring physical contact, and it is used in a range of manufacturing processes and detectors. Finally, WiFi Modules (also known as WLAN) are electronic components that enable a wireless internet connection in various products that convert a serial port. Thus, all the tools mentioned will be essential in making this project possible.



## **Data Collection Procedure**

In this capstone project, the developers will utilize the assessment tool to collect the necessary data from the chosen research participants through focus group discussion (FGD). The developers will perform alpha and beta testing to identify the errors and bugs in the system. The data collected and gathered from the participants will be handled securely and confidentially for data analysis.

Before collecting and gathering the data, the researchers will follow the rules and protocols wherein the developers will request approval from the head of the Research Program to perform the study. Additionally, the developers will also request approval from the school principal to conduct the testing. Upon receiving the approval, the developers will provide a letter of consent to the chosen participants who is the industry experts to participate in the development and testing. The consent indicates that they are part of the analysis, and they will also be aware of the intent of their involvement. The consent also states the study's purpose; this includes the confidentiality of the data gathered.

### *Phase 1: Development Stage*

The developers will collect the data as well as the errors and issues in the alpha testing process. In the beta testing, the product will be tested by the industry experts to collect data and errors to be reworked and fixed using the assessment tool. The developers will then undertake a focus group discussion (FGD) with the industry experts to evaluate the system's functionality and performance, as well as discuss solutions to address the issues discovered during the initial testing. In addition, all data collected during both testing phases will be kept confidential, and

industry experts will be informed about their participation in the project and testing process.

### *Phase 2: Testing Stage*

The developers will troubleshoot the difficulties, malfunctions, and errors identified by the industry experts after the alpha and beta testing is completed. After the system has been refined and redeveloped, it will be subjected to more testing and discussion. The previous phase's discussion will be beneficial and will be used to improve the product's performance and functionality once it is ready for market. The developers will repeat the testing and focus group discussion with the participants until the project goals are achieved.

### **Trustworthiness of the Study**

Many researchers have failed to adequately describe their assumptions and data in their study papers, particularly when it comes to data analysis. The purpose of this study's trustworthiness is to investigate how to ensure trustworthiness in this study by utilizing four components: *Credibility*, *Transferability*, *Confirmability*, and *Dependability*, all of which have been included in this study to ensure that it is free of any bias that could negatively affect anything that comes out of it.

*Credibility.* This study's triangulation will be data triangulation, in which data is validated through cross-verification from two or multiple sources, resulting in credibility. All the information gathered will be plausible and derived from the participant's original data. After testing the invention, all the data will be collected

through focus group discussion (FGD) and observations. Conducting "member checks" on a regular basis is required to ensure the study's authenticity.

*Transferability.* It should not be too difficult to understand a "deep" description of the participants and the research procedure, but there may be certain criteria to study to completely comprehend the study's background. The researchers will offer extensive information for the study descriptions to ensure that the study runs well and that a person can fully grasp or 'transfer' to another study. The researcher can improve transferability by clarifying the research background and concepts that were essential to the study.

*Confirmability.* The researchers will document procedures for reviewing and reviewing the data throughout the investigation to demonstrate the study's confirmability. Researchers must show data to the third-party examiner or participants, and they must review the survey to correct any errors they find. All misleading descriptions will be changed promptly after review to avoid reader misunderstanding and concerns. If it is acceptable, a participant can reject or withdraw their personal data.

*Dependability.* The degree to which the research procedure is recorded for the evaluator to follow, audit, collect data, and analyze the research process, as well as the consistency and dependability of the research findings. The data will be fully examined to identify any errors in the study's concept that can be immediately corrected. The evaluator should make certain that the research method is well recorded. This is done so that the study can be completely dependent.

## **Ethical Consideration**

The developers will always preserve the privacy of the individual and, as stated in the informed consent, will thoroughly verify their security. It will be extensively studied while maintaining identification and anonymity. The developers will take all of the information into ethical issues such as openness, fairness, privacy, secrecy, and safety while dealing with individuals at a societal level. Nothing will be directly related to the tester's name or the response information will be shared with others. They have the right to alter their minds and withdraw from study if they no longer choose to participate.

*Transparency.* Transparency embodies honesty and open communication. Developers should be open or prepared to keep details when it is inconvenient to do so. Transparency means being honest with oneself about one's actions. Transparency also refers to the developers being open and honest about their actions, as well as whether or not such acts are consistent with their values.

*Justice.* The concept of justice can be defined as ethical imperative to fairly distribute the rewards and costs of research. Developers must not use those who are powerless to their advantage, nor should they reject the people who desire to profit from project testers for a good cause.

*Informed Consent.* Implied consent is one of the ethical principles' core concepts. Human subjects should join the study willingly (voluntarily) after getting complete instructions about what it comprises and giving their approval before doing so, according to the developers.

*Social Value.* This capstone project takes extensive efforts to ensure that the testers' experiences are a 100% completely safe. The beneficial part of the risk analysis is discussed because no direct advantages are expected in testers. The term "social meaning" is inherently ambiguous, and it is employed in a variety of ways in the research ethics literature.

*Privacy and Confidentiality.* For research subjects, it is a term in ethical guidelines which states that an individual participating in human subject research has privacy rights. Many survey testers have issues after their privacy was violated as a result of their participation in research. It leads to a condition in which a researcher is aware of a research tester's identity but takes action to prevent the identification from being revealed to others. Topic confidentiality is not as widespread in research involving human subjects as it is in other fields since most human research needs signed documentation of consent.

*Risk, Benefits, and Safety.* During project design and ethical review, tester's safety is expressly considered. The developers are responsible for evaluating the potential risks and estimating the probability of the risk occurring. Thus, they will ensure the safety and benefits of the testers as it takes the process of the project's improvement.

*Qualification of the Developers.* The developers will guarantee that the capstone project will go through consideration, suggestions, consultations and comprehensive justification of the content by capstone research examiners. Consequently, the developers will provide necessary approval sheets and

documents as proof that the capstone project is conducted in Malayan Colleges Mindanao.

*Adequacy of Facilities.* Data collection will begin once the researcher receive the approval from the Research Program and school principal to conduct the testing. The developers will provide a letter of consent to the chosen participants who is the industry experts to participate in the development and testing.

*Community Involvement.* This capstone project ensures that no local customs, history, or people will be disrespected or jeopardized. The report, on the other hand, will be made available for academic purposes and for the good of society as a whole. In the context of this study, it will be presented at conferences on education.

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## APPENDICES

### Appendix A

Questionnaire
<b>Functionality</b>
Can the product register the data in the receiver's device?
Can the product detect the user's proximity?
Can the product monitor the student's data?
<b>Usability</b>
Is the product easy to use, and monitor?
Is there any inconsistency in the product's responsiveness, design aspects, or functionality?
<b>Reliability</b>
Are the data stored secure?
Can the device handle possible security breaches?
Is the device operational when required to use?
<b>Performance</b>
Is the device efficient in registering and transmitting data?
Is the device efficient in tracking the student's proximity?
+
Is the design of device appealing to the market?



